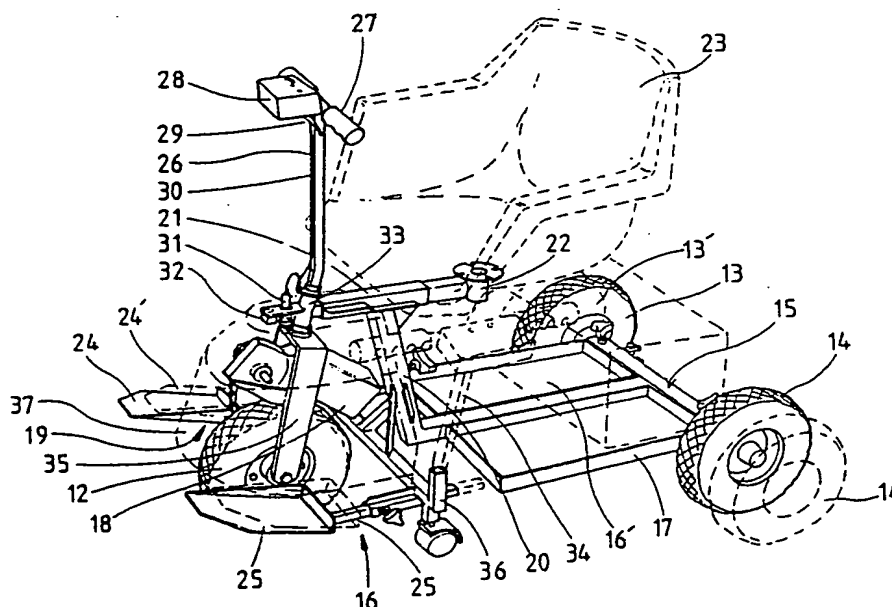


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY

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(21) International Application Number: PCT/AU92/00387 (22) International Filing Date: 27 July 1992 (27.07.92) (30) Priority data: PK 7441                      25 July 1991 (25.07.91)                      AU (71)(72) Applicants and Inventors: FAGG, Leigh, Kenneth [AU/AU]; 23 Luya Street, Fairfield, QLD 4103 (AU). DICKSON, Richard, James [AU/AU]; 12 Elaroo Street, Morningside, QLD 4170 (AU). (74) Agent: PETER MAXWELL & ASSOCIATES; National Bank House, 255 Adelaide Street, Brisbane, QLD 4000 (AU).		(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CS, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, PL, RO, RU, SD, SE, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, MC, NL, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).  Published With international search report.	

(54) Title: MOTOR CONTROL AND IMPROVED WHEELCHAIR



(57) Abstract

A wheelchair (10) having a frame assembly (11), a steerable driven front wheel (12), two rear wheels (13, 14) and a seat mounting means (22) located above and between the front and rear wheels such that the distance from the seat mounting means to the front wheel, is less than that to either of the rear wheels. The wheelchair has a removable steering column (26) with a handle (27) and manually operable control unit (28) adjacent the handle in a steering column mount (33); an electric motor (18) mounted in driving relation with the front wheel; a seat (23) behind the handle (27) so the driver can sit with legs astride the steering column; a control cable (30) extending from the control unit and having a plug (31) removably secured in a socket (32) adjacent the steering column. The cable is of length to allow the steering column to be removed from the steering column mount with the plug and socket connected. The controller for the electric motor receives a "motor off" or "motor on", such that the wheelchair stops gradually rather than suddenly.

MOTOR CONTROL AND IMPROVED WHEELCHAIRFIELD OF THE INVENTION

THIS INVENTION relates to motor control particularly for vehicles suitable for the aged and infirm and in particular, but not limited to wheelchairs, including motorised wheelchairs or the like.

BACKGROUND ART

At present, motor controllers particularly electric motor controllers for wheelchairs have a number of disadvantages. For example, in some circumstances, existing wheelchairs can accelerate out of control when moving downhill. In addition, present wheelchairs can topple over when power to the motor stops while the wheelchair is moving in the forward direction, particularly when the wheelchair is travelling downhill.

Quite apart from problems of motor control, existing self-drive wheelchairs are not "user friendly" and in some circumstances, are unsafe, lack adjustability and have low traction when travelling up hills.

It is an object of the present technology and associated innovations to alleviate at least to some degree the aforementioned problems associated with the prior art.

DISCLOSURE OF THE INVENTION

In one aspect, the present invention resides in the combination of an electric motor, an electric motor controller and a manually operable control unit suitable for driving a motorised wheelchair, the controller having a control input for receiving a "motor on" or "motor off" control signal from the control unit and an output for initiating delivery of power to the motor in response to a "motor on" signal delivered to the input and for stopping the motor in response to a "motor off" signal being delivered to the input so that the wheelchair stops gradually rather than suddenly.

In another aspect, the invention resides in the combination of an electric motor, an electric motor controller, a manually operable control unit and a wheelchair, the wheelchair having a frame assembly including a plurality of

wheels, the motor being mounted in driving relation with a said wheel, the controller having a control input for receiving a "motor on" or "motor off" control signal from the control unit and an output for initiating delivery of power to the motor in response to a "motor on" signal delivered to the input and for stopping the motor in response to a "motor off" signal being delivered to the input so that the wheelchair stops gradually rather than suddenly.

In a further aspect, the invention resides in a wheelchair including a frame assembly having a steerable driven front wheel, two rear wheels and a seat mounting means located above and between the front and rear wheels such that the distance from the seat mounting means to the front wheel is less than the distance between the seat mounting means and either of the rear wheels in order to distribute weight to obtain greater traction on the front wheel.

In still another aspect, the present invention resides in a wheelchair including a frame assembly having a steerable front wheel, rear wheels and a removable steering column mounted in a steering column mount, the steering column being in steering relation with the front wheel, an electric motor mounted in drive relation with the front wheel, the steering column having a handle and a manually operable control unit adjacent the handle, a seat behind the handle so that a driver can sit on the seat with his legs astride the steering column in order to manipulate the control unit and handle to drive and steer the wheelchair, a control cable extending from the control unit and having a plug, a socket adjacent the steering column into which the plug is removably secured, the plug comprising a self locating single pin which can be vertically located in the socket and the cable being sufficiently long so that the steering column can be removed from the steering column mount while the plug and socket remain connected so the driver can continue to drive the wheelchair forward with the steering column removed from its mount so the driver can manoeuvre himself into close proximity with a table or the like without the steering column impeding motion of the wheelchair.

In a still further aspect, the present invention resides in a self-drive wheelchair including a frame assembly having a steerable front wheel and two rear wheels, a seat between the front and rear wheels, a steering column in steering relation with the front wheel and an electric motor in driving relation with the front wheel, the rear wheels being laterally spaced apart and being adjustably mounted so the lateral spacing between the rear wheels can be altered to improve the stability of the wheelchair.

The frame assembly preferably comprises a base frame having front and rear portions, the rear wheels being mounted to the rear portion, the front wheel and seat mounting means being mounted to the front portion, the front portion having an upstanding frame member rigidly connected or integral with the rear portion and extending upwardly and forwardly from the rear portion, a rearwardly cantilevered frame member extending from the upstanding frame member and having a free end, the seat mounting means being located adjacent the free end of the rearwardly cantilevered frame member. Advantageously, the upstanding frame member includes a forwardly cantilevered frame member having a free end portion which is coupled to a pair of forks bridging around the front wheel, the forks having an axle on which the front wheel is rotatably mounted.

The wheelchair is preferably adjustable for drivers of different size. Typically, the position of the seat is adjustable fore and aft while footrests are preferably provided that are also adjusted fore and aft. Advantageously, the rearwardly cantilevered frame member is telescopic so the seat mounting means can be moved fore and aft.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In order that the present invention can be more readily understood and be put into practical effect, reference will now be made to the accompanying drawings and wherein:-

Figure 1 is a pictorial view illustrating one application of the present technology to a wheelchair according to the present invention;

Figures 2 and 3 are pictorial side views illustrating

two configurations of a reconfigurable wheelchair g to preferred embodiments of the present invention;

Figure 4 is a schematic wiring diagram illustrating an electric motor controller and control unit arrangement according to the present invention suitable for a wheelchair; and

Figure 5 is a pictorial view illustrating an accessory for a wheelchair.

#### DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawings and initially to Figure 1, there is illustrated a wheelchair 10 having a frame assembly 11 including a front wheel 12 and spaced rear wheels 13 and 14. The rear wheels 13 and 14 are telescopically mounted so that they can be extended laterally to the position shown at 13' and 14'. With this arrangement, spacing between the wheels 13 and 14 can be narrow for say, using the wheelchair in the aisles of a shopping centre where the wheelchair would normally be driven at low speeds and on a horizontal surface or the wheels can be extended to provide a more stable configuration for travelling over undulating terrain at reasonably high speed.

The frame assembly 11 includes a rear frame portion shown generally at 15 and a front frame portion shown generally at 16. The rear frame portion 15 includes trays 16' and 17 which normally carry batteries to supply the electric motor 18 which drives the front wheel 12 via sprocket and chain arrangement shown generally at 19. The front frame portion 16 includes an upstanding frame member 20 having a T piece 21, the T piece 21 takes a telescopic seat mount 22 so that a seat 23 can be adjusted in position fore and aft. Likewise, footrests 24 and 25 can be adjusted fore and aft between the positions shown at 24 25 and 24' and 25' respectively.

A steering column 26 is provided and includes a handle bar 27 and a control unit 28, the control unit 28 having a thumb operated lever 29 and as can be seen, the control unit 28 is configured for right hand thumb control but can be reversed for left hand finger control simply by turning the control unit 28 around. As will be seen from the following description, the control lever 29 controls a throttle pot arranged so that simply

by moving the control lever 29 to an opposed position to that shown and suitably positioning the control unit 28, the control lever can be arranged for left hand thumb control or right hand finger control in addition to the abovementioned control positions. Thus, any variations of position of lever 29 can be easily arranged to suit the capabilities of the aged or infirm person who might be using the chair. Thus, only minimal modification is required.

The steering column 26 includes a cable 30 extending from the control unit 28 to a jack plug 31 which is removable from a socket 32 with the plug employing a single pin which is easily locatable and removable from the socket 32. The steering column 26 is slidably removable from neck 33 and can be removed therefrom and placed in a storage position as shown in phantom at 34. The cable 30 is long enough so that as the wheelchair 10 is driven toward say, a table surface, where the driver may wish to partake of a meal, the chair can be slowly moved forward, the steering column can then be removed from the neck 33 of the forks 35 while the plug and socket 31 and 32 remain connected. The last stages of positioning can take place with the steering column held above the table surface until the chair is suitably positioned and then the steering column can be moved to the position illustrated at 34 and placed in the storage tube 36. The plug can be removed from the socket and the wheelchair rendered inoperable.

Referring to Figure 2, the wheelchair is shown in side view and as can be seen, the frame assembly 11 is designed to locate the centre of gravity of the forward portion of the frame assembly, the motor and the weight of the driver in a region above and close to the front wheel 12. Thus, as can be seen, the distance between the seat mounting 22 and the front wheel is less than the distance between the seat mounting 22 and the rear wheels 13 and 14. Thus, this provides improved traction particularly when travelling uphill.

Figure 3 illustrates the wheelchair of Figures 1 and 2 reconfigured for a walking mode of operation where a seated person is driven by a person walking behind the wheelchair and

as can be seen, the steering column 26 has been removed and reversed with an angled extension 26a inserted to give a preferred orientation for walk behind operation. The seat 23 has been turned about on its swivel mount. A canopy 38 is employed as an accessory and the footrests 25 and 26 have been moved to the rear of the wheelchair 10. In the illustrated embodiment, the wheelchair 10 includes footrest guides 39 and 40 at the front of the wheelchair and footrest guides 41 and 42 (see Figure 5) so again, in the configuration illustrated in Figure 2, the position of the seat and the footrests 25 can be adjusted fore and aft for different sized individuals.

In the illustrated embodiment, the seat 23 can be locked at 90° intervals, an individual mounts the wheelchair with the seat locked in a sideways facing position whereafter the individual swivels the seat of the wheelchair into either the self-drive position or the rear facing position as illustrated in Figure 3.

Other features illustrated in the drawings include a fibreglass or acrylic cowling 37 (shown in phantom) which provides an attractive lightweight cover for the motor 18 and upper portion of the front wheel.

Referring to Figure 4, a typical wiring diagram 43 for the control unit 28 and a suitable electric motor controller is illustrated and as can be seen, the wheelchair motor 18 operates in conjunction with an electromagnetic brake 44 which operates after the wheelchair is stopped or almost stopped. In other words, the electromagnetic brake does not bring about a sudden braking as would normally be the case. A suitable electromagnetic brake and electric motor combination is available from RAE Motor Corporation of 4615W Prime Parkway, McHenry, Illinois, U.S.A., but other functionally equivalent devices can be used. In the preferred form of the controller, the applicants choose to employ a commercially available electric motor controller suitably modified for the wheelchair application but functionally equivalent devices can be used. A suitable controller is Model 1208-235 available from Curtis PMC, a division of Curtis Instruments Incorporated of 6591 Sierra

Lane, Dublin, California, U.S.A., the Australian distributors of this controller being Bylong Industries Pty Ltd of 119 Killeaton Street, St. Ives, New South Wales, 2075. The controller is modified by removing the R62 resistor as marked on the printed circuit board and the controller is connected in circuit as shown in Figure 4 with the controller being represented generally as board 45.

The controller used employs a dynamic brake so that the wheelchair speed is governed. This is particularly pertinent as it prevents run-away when travelling downhill. The wheelchair speed is controlled by throttle pot 46 and for any throttle setting, a relatively constant speed is maintained over undulating terrain. The throttle pot 46 is configured to operate between a normal neutral position and full throttle over about  $20^{\circ}$  of arc,  $20^{\circ}$  either side of neutral and the lever 29 (see Figure 1) is biased to the neutral position. The pot selected has  $40^{\circ}$  of travel by reversing the terminal connections to the pot 46, the lever can be positioned in an opposed position to use the other  $20^{\circ}$  of arc so that the control unit can be positioned for left or right hand operation simply by this small adjustment. Fast or slow speed selection can be made on the control unit 28 (see Figure 1) by selection switch 47. Likewise, forward or reverse motion is switch selected by the triple pole triple throw switch 48 with the selection shown by LEDS 49 or 50.

In case the wheelchair breaks down, the whole controller can be shut down by the "free wheel" switch 51 so that the dynamic and electromagnetic brakes are released and the wheelchair can be pushed away for repair. Power is supplied by one or more batteries 52 with circuit breaker protection at 53. The control unit is connected to the controller via a six contact jack plug 31 and associated socket 54. The whole system is enabled and disabled by a key switch 55.

Referring now to Figure 5, there is illustrated an accessory which in this case is a shopping basket 56 mounted to the rear of the wheelchair. The footrest guides 41 and 42 serve a dual purpose by retaining mounting brackets 57 and 58 for the



30 basket 56. Also mounted on the bracket 57 is a walking cane holder 59.

It will be appreciated from the foregoing that the present invention provides in a preferred application a wheelchair which has substantial benefits over the prior art both in safety, adjustability and convenience of use. It will also be appreciated that whilst the above has been given by way of illustrative example of one preferred form of the present invention, many variations and modifications thereto will be apparent to those skilled in the art without departing from the broad ambit and scope of the invention as defended by the appended claims.

CLAIMS

1. In or for a motorised wheelchair, the combination of an electric motor, an electric motor controller and a manually operable control unit suitable for driving a motorised wheelchair, the controller having a control input for receiving a "motor on" or "motor off" control signal from the control unit and an output for initiating delivery of power to the motor in response to a "motor on" signal delivered to the input and for stopping the motor in response to a "motor off" signal being delivered to the input so that the wheelchair stops gradually rather than suddenly.
2. A wheelchair having an electric motor, an electric motor controller and a manually operable control unit, the wheelchair having a frame assembly including a plurality of wheels, the motor being mounted in driving relation with a said wheel, the controller having a control input for receiving a "motor on" or "motor off" control signal from the control unit and an output for initiating delivery of power to the motor in response to a "motor on" signal delivered to the input and for stopping the motor in response to a "motor off" signal being delivered to the input so that the wheelchair stops gradually rather than suddenly.
3. A wheelchair including a frame assembly having a steerable driven front wheel, two rear wheels and a seat mounting means located above and between the front and rear wheels such that the distance from the seat mounting means to the front wheel is less than the distance between the seat mounting means and either of the rear wheels in order to distribute weight to obtain greater traction on the front wheel.
4. A wheelchair including a frame assembly having a steerable front wheel, rear wheels and a removable steering column mounted in a steering column mount, the steering column being in steering relation with the front wheel, an electric motor mounted in drive relation with the front wheel, the steering column having a handle and a manually operable control unit adjacent the handle, a seat behind the handle so that a driver can sit on the seat with his legs astride the steering

column in order to manipulate the control unit and handle to drive and steer the wheelchair, a control cable extending from the control unit and having a plug, a socket adjacent the steering column into which the plug is removably secured, the plug comprising a self locating single pin which can be vertically located in the socket and the cable being sufficiently long so that the steering column can be removed from the steering column mount while the plug and socket remain connected so the driver can continue to drive the wheelchair forward with the steering column removed from its mount so the driver can manoeuvre himself into close proximity with a table or the like without the steering column impeding motion of the wheelchair.

5. A wheelchair according to any one of Claims 2 to 4, including a frame assembly having a steerable front wheel and two rear wheels, a seat between the front and rear wheels, a steering column in steering relation with the front wheel and an electric motor in driving relation with the front wheel, the rear wheels being laterally spaced apart and being adjustably mounted so the lateral spacing between the rear wheels can be altered to improve the stability of the wheelchair.

6. A wheelchair according to Claim 5, wherein the frame assembly comprises a base frame having front and rear portions, the rear wheels being mounted to the rear portion, the front wheel and seat mounting means being mounted to the front portion, the front portion having an upstanding frame member rigidly connected or integral with the rear portion and extending upwardly and forwardly from the rear portion, a rearwardly cantilevered frame member extending from the upstanding frame member and having a free end, the seat mounting means being located adjacent the free end of the rearwardly cantilevered frame member.

7. A wheelchair according to Claim 5, wherein the frame member has a forwardly cantilevered frame member having a free end portion which is coupled to a pair of forks bridging around the front wheel, the forks having an axle on which the front wheel is rotatably mounted.

8. A wheelchair according to any one of the preceding claims in which the position of the seat is adjustable fore and aft by means of telescopic mounting means.

9. A wheelchair according to Claim 8 in which the seat is locatable in selected disposition to face forwards, rearwards or sideways.

10. A wheelchair according to Claim 9 in which footrests are provided and selectively located according to the disposition of the seat.

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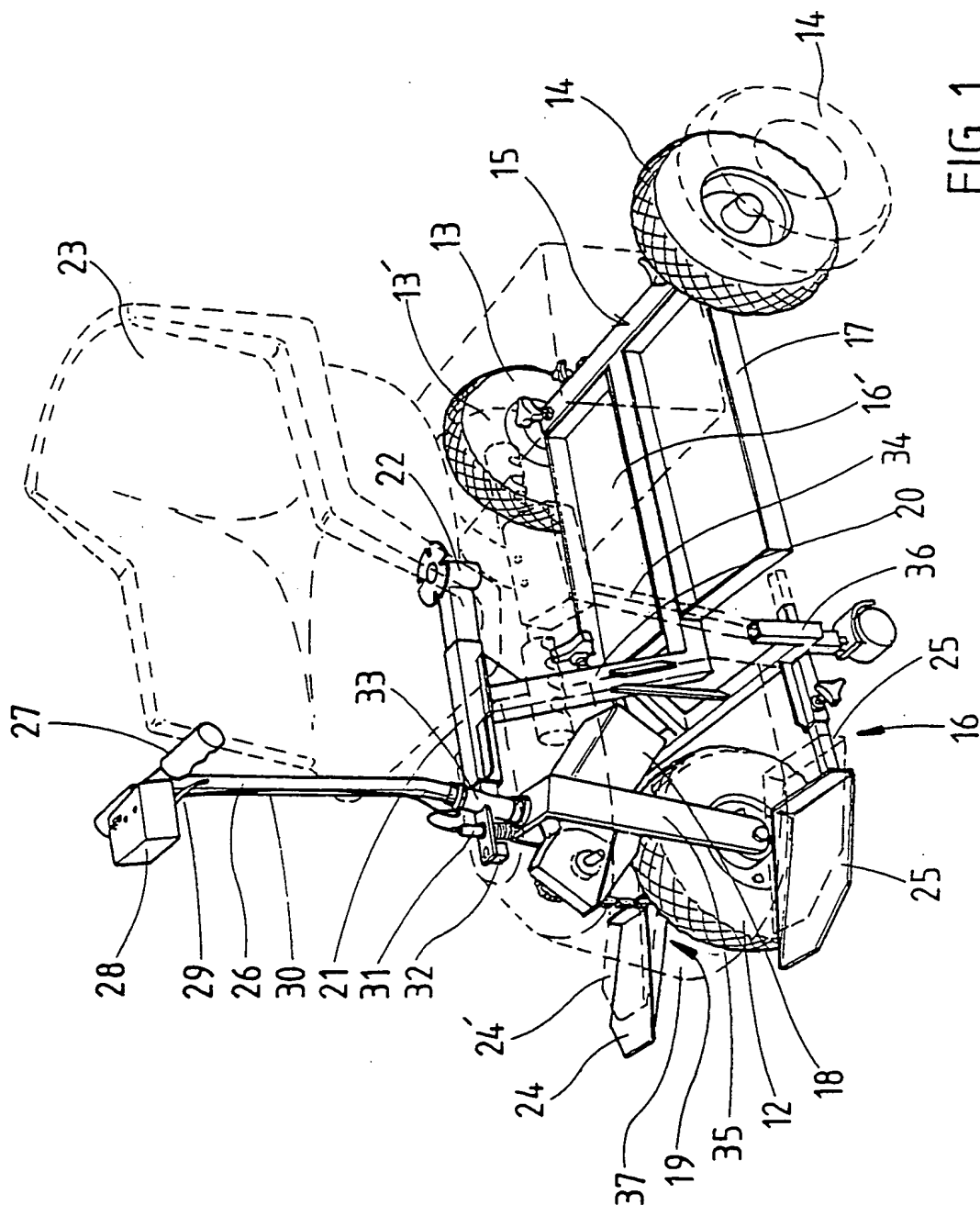
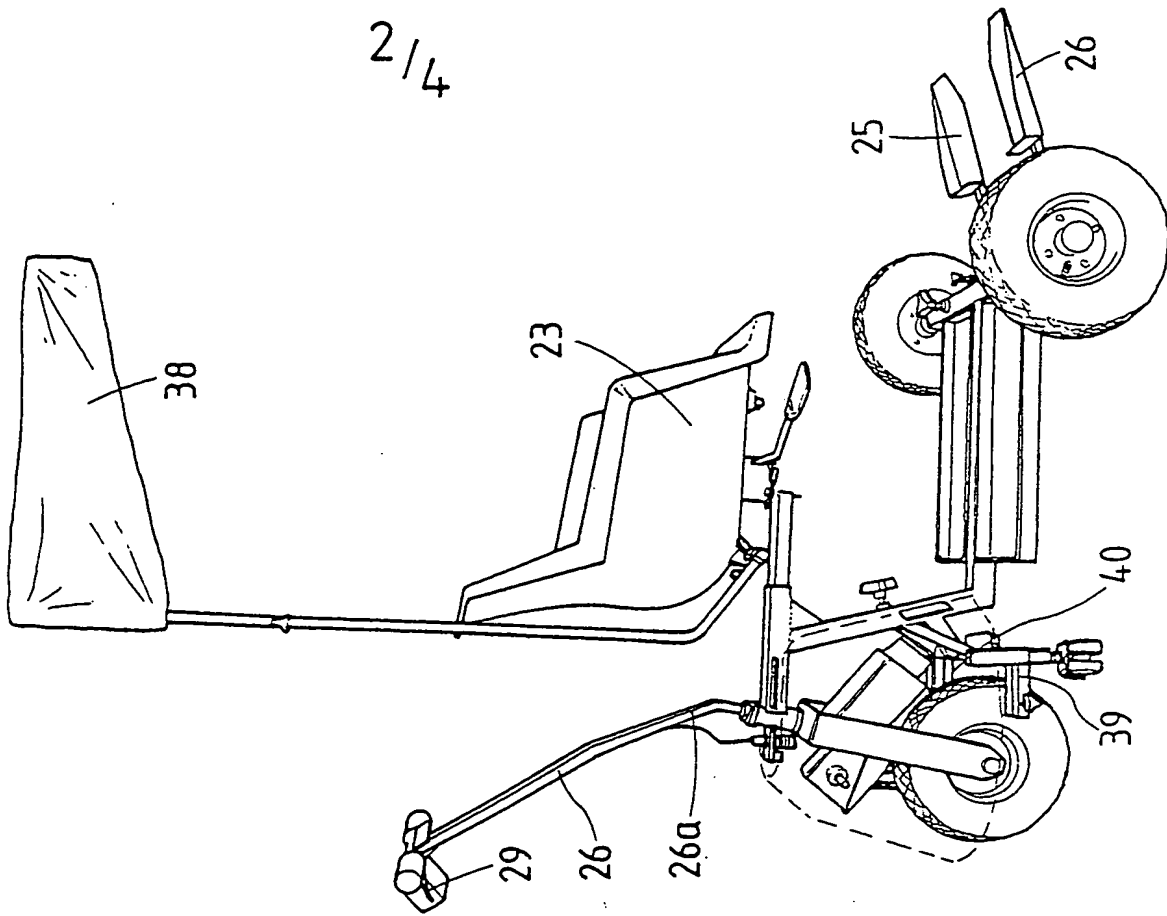
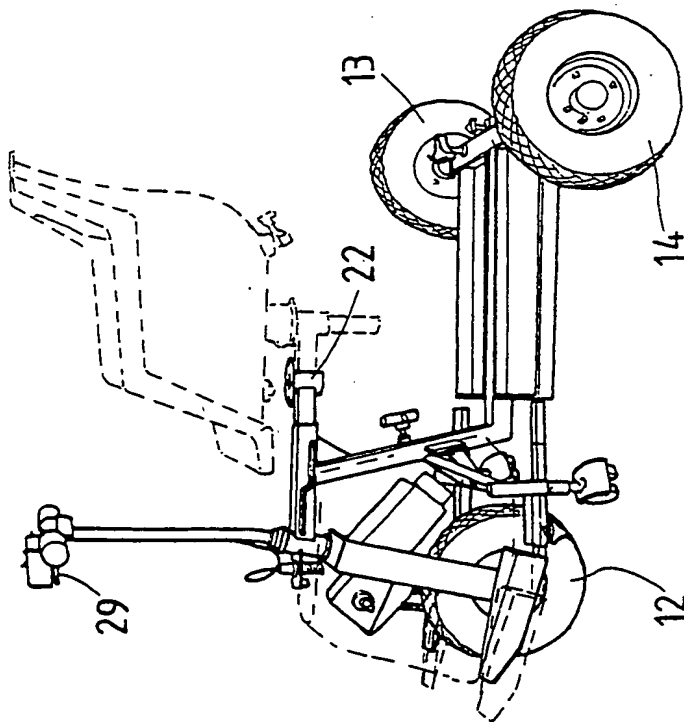


FIG. 1



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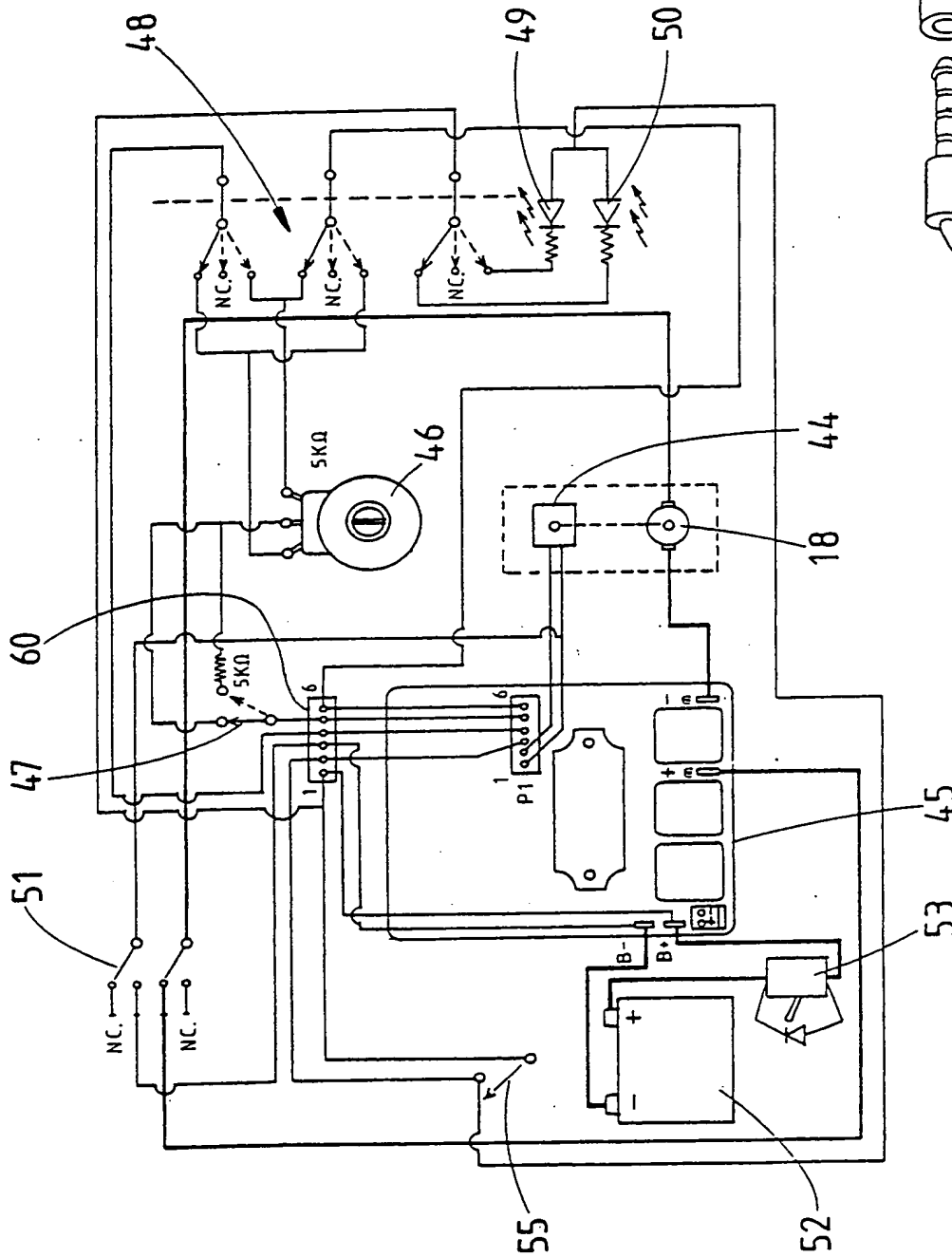


FIG 4

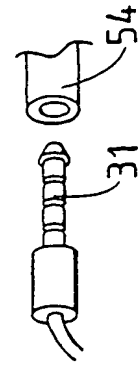


FIG. 4a

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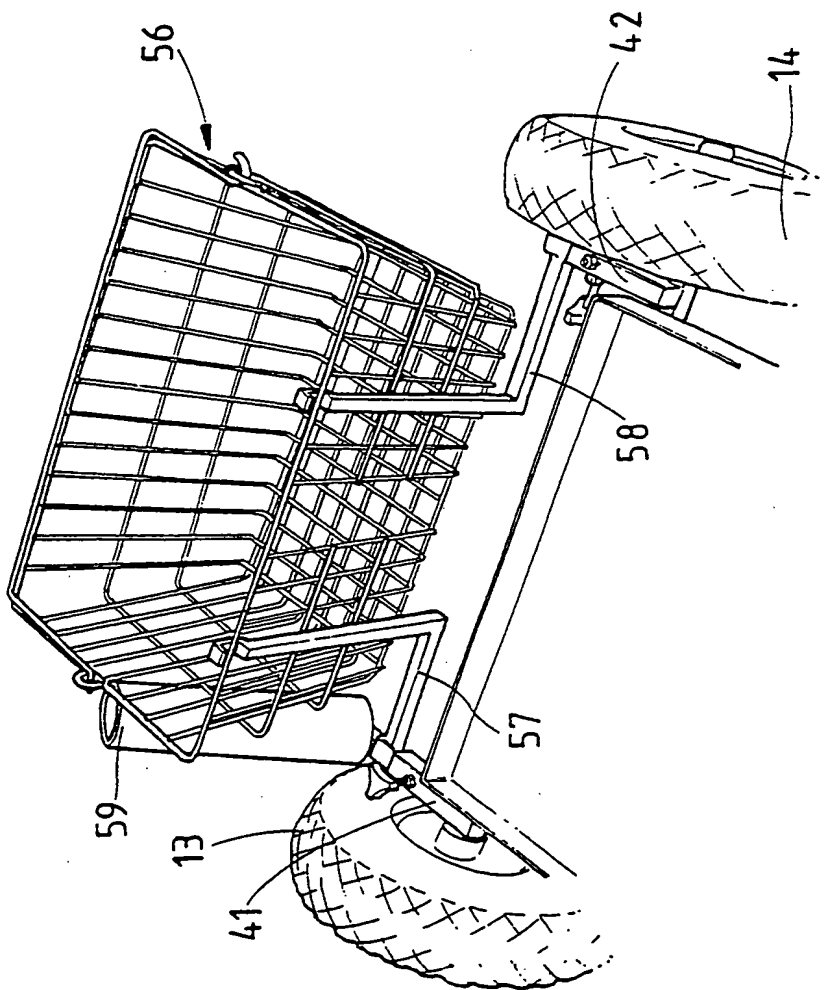


FIG 5



## INTERNATIONAL SEARCH REPORT

International application  
PCT/AU92/0038A. CLASSIFICATION OF SUBJECT MATTER  
Int. CL<sup>5</sup> A61G 5/04 // H02P 3/08, 3/16

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC A61G 5/04, H02P 3/08 3/16Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
AU :IPC as aboveElectronic data base consulted during the international search (name of data base, and where practicable, search terms used)  
DERWENT

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	FR,A,2248678 (BLONDEAU) 16 May 1975 (16.05.75) page 1, lines 20-21, figure 1.	1, 2, 10
X	US,A,3952822 (UDDEN et al) 27 April 1976 (27.04.76) Figure 3, column 4 line 50 - column 5 line 2.	1, 2
X	US,A,4511825 (KILMO) 16 April 1985 (16.04.85) column 3, lines 42-60, figure 1.	1, 2, 10

☒ Further documents are listed  
in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents :

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Date of the actual completion of the international search  
4 September 1992 (04.09.92)Date of mailing of the international search report  
21 Sept 1992 (21.09.92)Name and mailing address of the ISA/  
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	EP,A,255457 (CAUNEILLE) 3 February 1988 (03.02.88) claims 1 and 2, figure 1.	1, 2
X	Patent Abstracts of Japan C841, page 25, JP,A,3-73 145 (MATSUSHITA ELECTRICAL WORKS LTD.) 28 March 1991 (28.03.91).	1, 2

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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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US	4511825	US	4387325	CA	1207867 US 4634941
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		FR	2232463	GB	1463500 IT 1013411
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US	44523327	US	4534438		
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